A Computerized Decision Support System For Management Of Mechanical Ventilation In Patients With ARDS: An Example Of Exportation Of A Knowledge Base

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One of the problems with previous decision support systems was that knowledge rules developed for one particular hardware and software system were difficult to transfer to a different hardware and software platform. If decision support systems are to be useful throughout the medical community we must be able to export knowledge bases.

A computerized decision support system for the management of mechanical ventilation (respiratory evaluation, oxygenation, ventilation, weaning and extubation) in patients with adult respiratory distress syndrome has already been developed and clinically validated at the LDS Hospital [1, 2]. The protocol logic was developed using our existing consensus generating physician group and was implemented on the HELP system [3]. The computerized decision support system was used for over 35,000 hours in 111 Adult Respiratory Distress Syndrome patients and has controlled decision making 95% of the 24 hour day. The survival rate was 67%, higher than the expected 31-33% from historical data [4, 5], $p < 0.05$. These results have demonstrated that computerized decision support for critical care is feasible.

We are in the process of conducting a prospective randomized clinical trial to test efficacy of computerized protocols in 300 patients with ARDS at King Drew Medical Center (KDMC) a county hospital in the Watts district of Los Angeles, CA (H_0: There is no difference in efficacy between protocol and non-protocol controlled critical care).

In order to do this trial we needed to export the knowledge base (set of protocol logic rules) to a PC platform which could easily be installed at KDMC. The knowledge base was transferred from the HELP system at LDS Hospital to a PC based ICU computer system known as ARGUS Windows (ACT/PC, Madison , WI). ARGUS Windows runs under QNX V4.1 and QNX windows V2.03. The rules were implemented using a rule based decision support engine designed by ACT/PC. The engine is a finite state automata written in C for QNX and QNX Windows. Approximately 160 rules and a total of 400 states were implemented in the new engine. The transfer required approximately 0.5 FTE programmer and 0.5 FTE research nurse for testing. We feel that this is an example of collaboration between Academia and Industry to reach the desired goal of exportation of a complex knowledge base. The ARGUS Windows system has been installed at all 12 beds of the surgical ICU at KDMC. This system is now in routine use for respiratory care charting and the decision support system has been used to successfully care for 10 ARDS patients in a pilot study of feasibility. At the present time, 87-90% of instructions generated by the system are being followed by the clinical staff at KDMC.

In the randomized trial, we will define efficacy using a hierarchical four level approach; Efficacy → a)Survival, b) Length of ICU Stay, c) Morbidity, d) Incidence and severity of barotrauma. Generalizablity of the computerized decision support system will be determined by examining; 1) Percent of total time in the trial during which protocols controlled patient care. 2) Number of protocol instructions which were not followed. 3) Number of objections to protocol logic which, based on medical evidence, forced a change in the logic. To our knowledge this is the first prospective randomized clinical trial designed to test the impact of computerized critical care decision support on patient outcome.

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